Advances in Digestive Medicine (2016) 3, 80—87

Available online at www.sciencedirect.com

ScienceDirect

journal homepage: www.aidm-online.com

ORIGINAL ARTICLE

Altered anorectal function in rotating shift workers: Association with autonomic dysfunction and sleep disturbance

Jui-Sheng Hung, Tso-Tsai Liu, Chih-Hsun Yi, Wei-Yi Lei, Chien-Lin Chen*

Department of Medicine, Hualien Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation and Tzu Chi University, Hualien, Taiwan

Received 18 November 2014; accepted 16 March 2015
Available online 10 August 2015

KEYWORDS
Anorectal motility;
Heart rate variability;
Shift work;
Sleep

Summary *Background:* We aimed to investigate whether disruption of the circadian rhythm in rotating shift work (RSW) workers would change anorectal motility and cardiac autonomic function. We also determined whether sleep and psychological status (e.g., anxiety and depression) would affect anorectal motility in RSW workers.
Methods: Sixteen RSW workers and 11 control individuals were involved in the study. All study participants underwent anorectal manometry and spectral analysis of heart rate variability. All participants completed three questionnaires: the Pittsburgh Sleep Quality Index (PSQI), the State-Trait Anxiety Inventory (STAI) questionnaire, and the Taiwanese Depression Questionnaire (TDQ).
Results: The RSW workers had a lower threshold volume for maximal urge ($p = 0.006$) and greater rectal compliance ($p = 0.02$), compared to the controls. The RSW workers had a greater PSQI score ($p = 0.002$) and TDQ score ($p = 0.003$), compared to the controls. The RSW workers had a significantly increased low-frequency power percentage (LF%), compared to the controls ($p = 0.03$). The RSW workers had a significant correlation between the resting anal sphincter pressure and high-frequency power percentage (HF%; $r = -0.62$, $p = 0.01$), and between the R-R interval and the threshold for maximal urge ($r = 0.51$, $p = 0.04$). The PSQI score was significantly correlated with the threshold volume for urge ($r = 0.55$, $p = 0.03$) and for compliance ($r = 0.51$, $p = 0.04$) in the RSW workers.

* Corresponding author. Department of Medicine, Hualien Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation and Tzu Chi University, Number 707, Section 3, Chung-Yang Road, Hualien 970, Taiwan.
E-mail address: harry.clchen@msa.hinet.net (C.-L. Chen).

http://dx.doi.org/10.1016/j.aidm.2015.03.002

Conclusion: Rotating shift workers have anorectal dysmotility and cardiac sympathetic hyperactivity. Anorectal dysmotility in RSW workers has a close relationship with cardiac autonomic dysfunction, sleep disturbance, and depression, but not with anxiety.

Introduction

Disruption of the circadian rhythm in rotating shift work (RSW) workers has an impact on physical and mental health [1]. There is increasing evidence that RSW can lead to a variety of gastrointestinal symptoms [2], and possibly result in functional bowel disorders [3]. The effect of RSW on gastrointestinal disturbances is significantly associated with the type and duration of shift work [3,4]; the effect is particularly more severe in people on RSW than other types of shifts [3]. Furthermore, the effect of shift work on gastrointestinal symptoms is associated with sleep disturbances and psychological disorders, which suggests that poor sleep may deteriorate these shift work-induced symptoms [5,6]. However, other studies have demonstrated that the association between irritable bowel syndrome and RSW is independent of sleep disturbance [3].

Spectral analysis of heart rate variability (HRV) is a sophisticated and noninvasive tool for the identification of autonomic nervous system (ANS) control of the heart. Heart rate variability can be categorized into a high-frequency power component (HF; 0.15—0.40 Hz) and a low-frequency power component (LF; 0.04—0.15 Hz) [7]. The HF component and R-R interval are equivalent to respiratory sinus arrhythmia and are regarded as the vagal control of heart rate; the sympathetic and parasympathetic nerves jointly contribute to LF [8]. The low-frequency power percentage (LF%), high-frequency power percentage (HF%), and the ratio of LF to HF (LF/HF) may reflect sympathovagal balance, whereas LF% and LF/HF also represent sympathetic modulation [9,10]. The physiological explanation for very-low-frequency power (VLF) is less defined [7]. The variance in the HRV represents the parasympathetic effect [11]. Spectral analysis of HRV has shown reliable reproducibility in physiological and pathophysiological studies on cardiac autonomic function [12—14]. An earlier study with HRV has shown that shift work is associated with sympathetic hyperactivity [15]. A further study shows that the presence of sympathetic hyperactivity occurs more in people working permanently on night shifts [16]. In addition, we have previously demonstrated that the application of HRV can represent the autonomic control of gastrointestinal functions [17]. The 5-minute HRV has been widely utilized in our previous studies, and is adequate for representing ANS function in clinical studies [12,13,18,19]. By applying anorectal manometry, we have previously demonstrated that rectal compliance was correlated significantly with poor sleep, as determined by the Pittsburgh Sleep Quality Index (PSQI) score, which suggests that poor sleep may predispose previously healthy individuals to constipation [13,20,21]. In this study, we aimed to test the hypothesis that the disruption of the circadian rhythm by RSW would affect anorectal motility and cardiac autonomic function. We also investigated whether sleep and psychological statuses (i.e., anxiety and depression) would predispose an individual to altered anorectal motility relevant to RSW.

Methods

Participants

All study participants provided written informed consent and were interviewed about their work status, general health, and gastrointestinal symptoms before the study. Sixteen RSW workers and 11 control study participants who only worked days participated in this study. The definition of RSW was judged and qualified on the work with rotation between day shift and night shift for at least 3 rotating nights/mo [22]. No study participant had any history of an underlying medical condition, previous gastrointestinal surgery, gastrointestinal symptoms, or clinical conditions that affected HRV. Individuals with poor communication or impaired hearing were excluded. All individuals were enrolled from a community and/or university population by public advertisement. The study protocol was reviewed and approved by the research ethics committee of Buddhist Tzu Chi General Hospital (Hualien, Taiwan). The study recruitment period was between January 2012 and August 2012.

Anorectal manometry

All study participants were instructed to evacuate the rectum and received a Fleet's enema before the test. The probe was a 4.5-mm diameter, solid state catheter with multiple pressure transducers (Sandhill Scientific, Inc., Highlands Ranch, CO, USA) and a lumen for balloon inflation. A 5-cm balloon was tied to the distal end of the catheter. The lubricated catheter was introduced into the rectum as the study participants lay on their left side with their hips and knees flexed to 90°. The average resting and squeeze pressures (i.e., maximum and sustained) were recorded by the stationary pull-through technique. The threshold volume for rectoanal inhibitory reflexes (RAIR) was assessed by distending the rectal balloon in progressive 10-mL decrements, starting at 60 mL, until anal sphincter relaxation occurred at a lower volume of distension. Rectal sensation was evaluated using a rectal balloon inflated at an interval of 10 mL until the individual reported the first